

bored in places. The four derivatives of a function are dull, and no one will ever make them seem anything else; and a good deal of Brodén's work is much more solid than inspiring. Occasionally we do not quite like Dr. Hobson's choice of words—in particular we may instance his use of "indefinitely great," in such phrases as "has indefinitely great values," "the functional value is regarded as indefinitely great," "the lower limit is indefinitely great." Why not, in the last case, simply "there is no lower limit"? Dr. Hobson could reply that he has expressly warned the reader against any such confusion of thought as is sometimes implied in modes of expression such as these; and there is certainly none in his own mind. None the less we wish that he had expressed himself in a different manner.

In this chapter, let us single out for special praise the sections on double and repeated limits (pp. 303 *et seq.*). We particularly like the author's generalisation of the definition of a repeated limit, which enables him to simplify the statements of a number of theorems. We have already said that we do not altogether like the arrangement of the next two chapters. Surely it would have been better to introduce the notion of a series at an earlier stage. As it is, some of the theorems concerning integrals are separated from one another in a rather irritating way. But most of the discussions of particular theorems are admirable. We may mention especially the treatment of the "absolutely convergent improper integral" (pp. 364 *et seq.*), the sections on the transformation of double integrals (pp. 445 *et seq.*), and the account of Baire's theory of the representation of functions (pp. 522 *et seq.*). A few criticisms of details suggest themselves. Is it worth while to define "principal values" if nothing more is to be said about them? There is a curious slip on p. 454, l. 14; obviously the condition stated is not necessary; and it is very odd that Dr. Hobson should define *divergence* and *oscillation* in such a way that $1-2+3-4+\dots$ is a divergent rather than an oscillating series. The last word has not yet been said about Weierstrass's non-differentiable function (pp. 620 *et seq.*). What about $\sum a^n \cos b^n x$, where ab is only a little greater than 1? One would expect the function to have no differential coefficient whenever $ab \geq 1$; but no one seems to have found out whether this is the case or not.

Finally, chapter vii. (Fourier's Series) shows Dr. Hobson quite at his best. The last part, in which he supplies a final touch of rigour to some of Riemann's work, is extremely difficult, but that was inevitable. The remark at the foot of p. 647 is open to dispute. Was not something very much like the theorem, ascribed to Lerch on p. 727, also proved by Stokes? On p. 732, l. 24, for "diminished" read "increased."

A short appendix contains some further critical remarks, in addition to chapter iii. We wish that there had been space for a summary of König's rather watery theories, and the author's neat and convincing reply in the London Mathematical Society's Proceedings. We must confess to a strong temptation to argue with Dr. Hobson concerning the remarks at the top of p. 765, but the temptation must be resisted.

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Dr. Hobson has attempted an appalling task. There is no region of pure mathematics (unless it be the theory of numbers) which is quite so difficult as this; certainly none of which the literature is so scattered and so difficult to collate, or in which the writing of a big book requires a greater combination of drudgery and critical insight. All things considered, he has succeeded wonderfully. We can think of no one else who would have done half as well. G. H. H.

LIEBIG AND GÜSSEFELD.

Justus von Liebig und Emil Louis Ferdinand Güssefeld. Briefwechsel: 1862-1866. Herausgegeben von Dr. O. E. Güssefeld. Pp. viii+72. (Leipzig: Johann Ambrosius Barth, 1907.) Price 3 marks.

THIS little book has a twofold interest. To the scientific agriculturist it is interesting as elucidating the history of the introduction of the modern methods of agriculture into Germany, and especially of the introduction of the so-called chemical fertilisers, due largely to the teaching and influence of Liebig; it serves also to throw some sidelights upon the character and habits of Liebig himself, and is therefore of interest to the historian of chemistry. It consists simply of a collection of thirty-eight letters which passed between Liebig and Emil Güssefeld from 1862 to 1866, twenty-two of which are contributed by Liebig, and the whole has been arranged for publication, with explanatory notes and annotations, by the pious care of the son of one of the correspondents.

Emil Güssefeld was a Hamburg merchant, of the conventional type, dealing mainly in coffee and other colonial products. In a fortunate hour he accepted an agency from an American company for the sale in Germany of guano from Baker Island, in the Pacific Ocean, and thereby laid the foundations of a prosperous business in phosphatic manures. Emil Güssefeld indeed stands to Germany in much the same relation that the late Sir John Bennett Lawes stands to this country, and both reaped fame and fortune by the far-sighted enterprise which induced them to give practical effect to the theoretical views of Liebig. As a prudent man, Güssefeld, before undertaking the agency, seems to have consulted Liebig as to the probability that the Baker guano, of the merits of which he was well assured, would find a ready sale among a body of agriculturists who are even more conservative than our own, and Liebig's reply constitutes the first letter in the series. It is in every respect worthy of him—sound, thoughtful, and considerate, and with that note of cautious optimism which the eminently practical mind of the Hamburg merchant could not fail to appreciate. Liebig, as this correspondence abundantly testifies, never spared himself when his interest was aroused, and he was ever ready to give of his best, without fee or thought of reward, when the object commended itself to him. In this large-hearted liberality Liebig resembled Davy, who nearly half a century previously had striven in the same self-sacrificing way to infuse something of the scientific spirit into the oldest of the arts. Liebig's letters are rich in practical advice, business hints, analytical information

—all given with no other thought than of doing what in him lay to further the true interests of agriculture. How greatly Güssefeld benefited by his wise counsel, and what material advantages he gained from Liebig's altruistic interest in the development of the industry of which he was a pioneer in Germany, Güssefeld's letters clearly indicate. His letters, too, indicate his sense of gratitude. He repeatedly pressed upon his distinguished correspondent his earnest desire to make some substantial recompense, but Liebig declined to entertain any thought of pecuniary reward. All Güssefeld could do was to appeal to one of the most characteristic of Liebig's frailties. He was, to quote Dr. O. E. Güssefeld, a "leidenschaftlicher Raucher und wollte schwere und nur gute Zigarren haben." These, we are told, are particularly easy to obtain in Hamburg; and we are assured by Liebig that Güssefeld sent him of the best the city could furnish, and kept him well supplied. There is much virtue in a good cigar; how much German agriculture owes to it may be plainly discerned in this interesting correspondence.

T. E. T.

BOTANICAL WORKS.

- (1) *Botanisches Jahrbuch*. Edited by Dr. A. Engler. Vols. xxxvi to xxxix. (Leipzig: W. Engelmann, 1905-7.)
- (2) *Das Pflanzenreich*. Edited by Dr. A. Engler. Vols. xxii to xxvi, xxvii and xxix. (Leipzig: W. Engelmann, 1905-7.)
- (3) *Recueil de l'Institut botanique*. Edited by Dr. L. Errera and Dr. J. Massart. Vols. i, ii, and vi. (Bruxelles: H. Lamertin, 1906.)

(1) ENGLER'S "*Botanisches Jahrbuch*" serves mainly as a repository for information on systematic botany and plant geography. The issue is peculiar, as usually three or four volumes are in progress simultaneously, but the irregular appearance of the parts serves to ensure rapid publication of papers containing new identifications. Vol. xxxvi was begun and completed in 1905, but the three succeeding volumes form a simultaneous triad that date from September, 1905, to March, 1907. Throughout the four volumes there are only four instalments of the "Beiträge zur Flora von Afrika," in which special interest attaches to the Orchidaceæ and Asclepiadaceæ mostly collected and described by Mr. R. Schlechter, two new genera of the Podostemonaceæ founded by Dr. A. Engler, the collation of the Combretaceæ by Dr. L. Diels, and the list compiled by Dr. F. Pax of plants collected by Mr. F. Rosen in Abyssinia. Another monograph of a similar nature is concerned with the plants collected by Dr. A. Weberbauer on a tour of exploration over the highlands of Peru, of which a brief outline was given in vol. xxxii, and a map with the two first instalments of determinations prepared by various workers under the editorship of Prof. I. Urban appears in vol. xxxvii. Dr. Weberbauer also contributes two short articles that may be regarded as preparatory to a volume for the series "*Die Vegetation der Erde*."

The subject of insular floras is enriched by several

papers. To a phytogeographical account of New Caledonia, Mr. R. Schlechter has added a systematic account of the flora, and Dr. E. Lemmermann has compiled a list of algæ collected in the Chatham Islands.

Among the summaries representing recent work on individual orders and genera, a general comparative account of the Cornaceæ is presented by Mr. W. Wanguerin. The review of the order Valerianaceæ by Dr. P. Graebner affords an indication of a more elaborate commentary to appear in a future volume of the "*Pflanzenreich*." The genus *Anemone* forms the subject of a monograph by Dr. E. Ulbrich.

Two papers of more universal interest are provided in the accounts of myrmecophilous plants by Mr. E. Ule and Mr. H. v. Ihering. The symbiotic hypothesis, as well as the view that the hollow spaces in the stems are the result of natural selection, are refuted. The biology of tropical flowers and fruits is discussed by Prof. H. Winkler, and an ecological study of the vegetation on some newly-formed islands in a Swedish lake is described by Mr. S. Birger.

(2) "*Das Pflanzenreich*" has attained to twenty-nine volumes, of which eight have been published since November, 1905. The volume on the Primulaceæ has been prepared by Prof. F. Pax and Dr. R. Knuth. The genus *Primula* is remarkable, both for the beauty of the flowers and its wide distribution. From the map provided it will be seen that centres of distribution occur in Switzerland and in the Himalayas, but the richest source lies in western China. Dr. A. K. Schindler has contributed the monograph on the Halorrhagaceæ, from which he excludes the genus *Hippuris*. Dr. Fr. Buchenau has summarised the fruits of his researches in the volume on the Juncaceæ. The anatomy of the leaves, the germination of the seedlings, and the numerous hybrids are important features of the order. Prof. L. Diels is responsible for the Droseraceæ, that show many interesting characters in anatomy, regeneration, and growth forms. In dealing with the Polemoniaceæ, Dr. A. Brand pays special attention to the work of American botanists. The latest volume by Mr. O. E. Schulz is concerned with the Erythroxylaceæ.

(3) The papers collected in these volumes of the "*Recueil de l'Institut botanique*" of Brussels constitute a scientific memorial to the late Prof. Errera, as they represent research carried out by him or inspired by his influence. The first volume contains several papers by Prof. Errera on glycogen in plants, and contributions on the same subject by Dr. E. Laurent and Mr. G. Clautriau. In the second volume is published a series of papers dealing with the cycle of nitrogen compounds, including those by Dr. E. Laurent on the reduction of nitrates, and Mr. E. Marchal's account of ammonia formation in the soil by bacteria. Another important collection of papers relates to alkaloids and proteid substances. This series begins with the paper on the localisation and significance of alkaloids in plants, written by Prof. Errera in conjunction with Dr. Maistriau and Mr. G. Clautriau. The next three volumes are reserved for papers published before the year 1903. The sixth